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Fusion of AIRSAR and TM Data for Parameter Classification and Estimation in Dense and Hilly Forests

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The expanded remotely sensed data space consisting of coincident radar backscatter and optical reflectance data provides for a more complete description of the Earth surface. This is especially useful where many parameters are needed to describe a certain scene, such as in the presence of dense and complex-structured vegetation or where there is considerable underlying topography. The goal of this paper is to use a combination of radar and optical data to develop a methodology for parameter classification for dense and hilly forests, and further, class-specific parameter estimation.

The area to be used in this study is the H. J. Andrews Forest in Oregon, one of the Long-Term Ecological Research (LTER) sites in the US. This area consists of various dense old-growth conifer stands, and contains significant topographic relief. The Andrews forest has been the subject of many ecological studies over several decades, resulting in an abundance of ground measurements. Recently, biomass and leaf-area index (LAI) values for approximately 30 reference stands have also become available which span a large range of those parameters. The remote sensing data types to be used are the C-, L-, and P-band polarimetric radar data from the JPL airborne SAR (AIRSAR), the C-band single-polarization data from the JPL topographic SAR (TOPSAR), and the Thematic Mapper (TM) data from Landsat, all acquired in late April 1998. The total number of useful independent data channels from the AIRSAR is 15 (three frequencies, each with three unique polarizations and amplitude and phase of the like-polarized correlation), from the TOPSAR is 2 (amplitude and phase of the interferometric correlation), and from the TM is 6 (the thermal band is not used). The range pixel spacing of the AIRSAR is 3.3m for C- and L-bands and 6.6m for P-band. The TOPSAR pixel spacing is 10m, and the TM pixel size is 30m.

To achieve parameter classification, first a number of parameters are defined which are of interest to ecologists for forest process modeling. These parameters include total biomass, leaf biomass, LAI, and tree height. The remote sensing data from radar and TM are used to formulate a multivariate analysis problem given the ground measurements of the parameters. Each class of each parameter is defined by a probability density function (pdf), the spread of which defines the range of that class. High classification accuracy results from situations in which little overlap occurs between pdfs. Classification results provide the basis for the future work of class-specific parameter estimation using radar and optical data.

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